Independent Claim 1 is directed to a rotating electric machine having a magnetic circuit for high voltage. The rotating electric machine has a stator having a winding of a high-voltage cable, and a rotor. The cable includes a flexible conductor surrounded by a solid insulation having an inner layer with semiconducting properties, an insulating part, and an outer layer with semiconducting properties.

Claim 1 was rejected based upon a hypothetical machine having a stator and a stator winding according to the machine in Shildneck, but substituting the stator winding of the machine in Shildneck with the high-voltage cable in Elton. Applicants respectfully traverse this rejection.

Shildneck describes a low-voltage, high-current machine with unconventional windings. As shown in Figures 1-4, the outermost layer of the winding in Shildneck (i.e., element 8 in Figures 1-4) is made of an insulation material.[1] For higher voltages (say over 5 kV – depending on the insulation material used and insulation thickness), it is necessary to take steps to eliminate corona between an insulated conductor and a metallic member. Such corona will form in any small air pocket between the insulation material and stator slot, provided that sufficient voltage (3 kV/mm which is the condition for forming a partial discharge path in air) appears across the air space. This is, for example, discussed in US Patent No. 2,613,238, a patent cited by Shildneck (col. 1, line 60). It is known to paint a surface of insulated conductors lying in core slots of large electrical machines with semi-conducting material to establish a sheath of reasonably uniform potential at the winding within the stator slot. Despite the fact that this is known, Shildneck does not address the problem of corona discharge, which to some extent could be reduced by using thicker insulation. Instead, one object of Shildneck is to reduce the thickness required in the ground insulation (by providing a round conductor).

---

[1]See Shildneck, at column 3, lines 60-63.

In machines operating at higher voltages, such as conventional machines which normally operate between 10 and 20 kV, sometimes up to 30 kV, the end portion of the winding is normally provided with an electric field control in the form of so-called corona protection varnish intended to convert a radial electric field into an axial field, which means that the insulation on the end-winding region is subject to a high potential relative to ground. The electric field control evens out the dielectric stress of the insulating material in the end-winding region, but an electric field concentration is still a severe problem in electrical machines operating at these higher voltages.

Shildneck does not have any electric field control, which is not surprising for machines that are configured to operate at lower voltages, such as the machine in Shildneck. Conventional insulation of conductors in electrical machines (such as so-called mica-tape) is produced to some extent to provide resistance to partial discharge. If the ground insulation material as used by Shildneck (silicon rubber), were subjected to partial discharge, it would eventually lead to a deterioration of the insulation material. Also, if the machine in Shildneck were operated at voltage levels of higher voltage conventional machines, the uncontrolled electric field in the end-winding region would also result in high electric field concentrations causing a high dielectric stress of the insulation material, leading to a deterioration of the insulation material, and eventual breakdown of the machine. Accordingly, it is respectfully submitted that the cable used in the machine in Shildneck and the machine itself are designed for operation only at low voltages. Moreover, there is nothing in Shildneck suggesting a desirability to modify the cable and/or machine to operate at higher voltages.

Elton is asserted for its teaching of having an electrical cable having an internal grading layer of semicoducting pyrolyzed glass fiber in electric contact with the cable conductor. Elton is further asserted for its teaching of an electrical cable provided with an exterior layer of semiconducting pyrolyzed glass fiber in contact with an insulation with a

predetermined reference potential. However, Elton does not teach or suggest what is also lacking in Shildneck, namely, having a high-voltage cable as a stator winding that is drawn through the slots of the stator. Furthermore, there is nothing in Elton suggesting a desirability for using a high-voltage cable as a stator winding.

The invention of Elton is about an insulator material, namely, a pyrolyzed glass fiber layer that may be used in a variety of applications. For example, Elton describes surrounding conventional bar-type windings of an electric machine with a layer of pyrolyzed glass fiber in electrical contact with ground to minimize corona discharge by providing a path to ground to bleed off built up charges.[2] Elton also describes using a semiconducting pyrolyzed glass fiber layer to equalize the potential on the exterior of the insulator of a cable.[3] Elton describes yet another application of the pyrolyzed glass fiber layer as a way to protect electronic components by coating the exterior surface of a housing with the semiconducting pyrolyzed glass fiber.[4] However, there is nothing in Shildneck to indicate a desirability for a winding having different properties than the cable winding disclosed therein. Moreover, as discussed above, Shildneck is inherently designed for operation at low voltages. Accordingly, there is nothing in Shildneck to suggest a motivation to change the winding in Shildneck, nor anything to suggest that it is feasible to operate with cable windings that operate at high voltage. Further, as discussed above, there is nothing in Elton to suggest a desirability or motivation to use the cable, shown in Figure 7 of Elton, as a winding in an electric machine.

Elton does not teach or suggest that the cable shown in Figure 7 could be used as a winding in an electric machine. On the contrary, the cable in Elton is but one of several exemplary applications of the pyrolyzed glass fiber layer described in Elton. It appears to be completely coincidental that Elton uses a winding and also a cable (as well as a chassis for an electric circuit) as exemplary uses for the pyrolyzed glass insulator material. There is nothing

---

[2]See Elton, at column 2, lines 44-48, and Figures 1-6.
[3]See Elton, at column 7, lines 12-17, and Figure 7.

in Elton to suggest a desirability of using the cable shown in Figure 7 of Elton as a substitute for a conventional bar-type winding in an electric machine.

The outstanding Office Action asserts that the motivation for combining Shildneck and Elton would be to "prohibit the development of corona discharge and would equalize the electrical charge generated between two layers."[5]

With regard to the stator winding embodiment, Elton recognizes that in the end-winding region, just outside of the stator of an electric machine, there will be problems caused by strong electric fields. As a solution, Elton uses a known grading near the stator to allow some of the accumulated charge to bleed off to the stator, thus reducing the risk of arcing, but Elton offers no other solutions to the problems in the end-winding region. The strong electric fields will be present throughout the end-winding region, not just near the stator. The grading used in Elton will help to lessen the effects of the strong electric fields near the stator, but will not address the problems in the end-winding region away from the stator. Elton uses rigid bar-type windings that are able to withstand mechanical stresses caused by induced fields between the windings in the end-winding region, where electromagnetic fields are not contained in the winding. The mechanical rigidity of the bar-type windings suppress the amount of vibration in the end-winding region that would otherwise be present. The fact that a grading system is used to lessen the end-winding region problems near the stator in Elton is further evidence that Elton does not suggest using the cable of Figure 7 as a winding of a machine, since such a cable would not need the grading system.

The "invention" in Elton is the pyrolyzed glass fiber layer. Elton describes a process of immersing the winding portions in a bath of resin and vacuum pressure impregnating (VPI)

---

[4]See Elton, at column 7, lines 38-43, and Figure 8.
[5] See Office Action dated October 11, 2001, at numbered paragraph 3, p. 3.

the resin in the winding.[6] The VPI process results in a cured resin having no voids or gaps between layers.[7] The cured resin is a hard material, which is an important observation, since the flexible winding of Shildneck would be replaced with a pyrolyzed glass-based cable of Elton.

The cable shown in Figure 7 of Elton includes two pyrolyzed glass fiber layers, layers 104 and 110.

> The internal grading layer 104 is a semi-conducting pyrolyzed glass fiber layer as disclosed herein. . . . An insulation 106 surrounds internal grading layer 104. On the external surface of insulation 106, a semi-conducting pyrolyzed glass fiber layer 110 equalizes the electrical potential thereon.[8]

As further evidence that the cable shown in Figure 7 Elton would not be suitable as a winding in an electric machine, having two cured, pyrolyzed glass fiber layers would cause the cable to be prohibitively stiff for winding through the stator slots. It may be possible to VPI the entire stator in a large resin bath after it had been wound with a flexible cable. However, such a process would be ineffective for applying and curing the resin for both the internal grading layer 104 and the external layer 110, since an insulation layer 106 surrounds the internal grading layer 104. It would not be possible to expose both layers 110 and 104 to the resin. Accordingly, while Elton describes how to provide a pyrolyzed glass fiber layer for a bar-type winding, Elton does not teach or suggest that the cable of Figure 7 could be used for such a purpose, especially since the cable in Elton would be stiff, not flexible once the pyrolyzed glass material is cured.

Consequently, it is respectfully submitted that no matter how Shildneck is combined with Elton, the proposed combination fails to teach or suggest the invention defined by Claim 1, or Claims 2-7 dependent therefrom.

---

[6] See Elton, at column 4, lines 23-25.
[7] See Elton, at column 4, lines 27-30.
[8] See Elton, at column 7, lines 19-26.

Starcevic is asserted in the rejection of Claims 3-6 for its teaching of a support for the stator and rotor elements. Aside from these supports, there is nothing in Starcevic that would cure the above-described deficiencies regarding the proposed combination of Shildneck and Elton. Consequently, it is respectfully submitted that no matter how Shildneck is combined with Elton and Starcevic , the proposed combination fails to teach or suggest the invention defined by Claim 1, or Claims 3-6, dependent therefrom.

Consequently, in light of the foregoing comments, it is respectfully submitted that the invention defined by Claims 1-7 is patentably distinguishing over the asserted prior art. The present application is therefore believed to be in condition for formal allowance and an early and favorable reconsideration of this application is respectfully requested.

Respectfully submitted,
OBLON, SPIVAK, McCLELLAND,
MAIER & NEUSTADT, P.C.

Bradley D. Lytle
Registration No. 40,073
Attorney of Record
Thomas J. Fisher
Registration No. 44,681

22850

Tel. No.(703) 413-3000
Fax #: (703) 413-2220
BDL:TJF:fbl
I:\atty\tjf\9847\196946\196946US.am.doc